Distribution and habitat use of Crested Larks *Galerida cristata* at Loiyengalani, Kenya

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The Crested Lark *Galerida cristata* is a widespread and polytypic species (Cramp 1988). In Africa, the bird ranges widely to the north and south of the Sahara, along the Nile Valley, and—the race *somaliensis*—in northern Kenya, southeastern Ethiopia, and northern Somalia (Keith *et al.* 1992). In Kenya, Crested Larks are common in sandy semi-desert in the northwestern quarter of the country (Lewis & Pomeroy 1988). The species is considered mainly resident (Cramp 1988, Keith *et al.* 1992). In Europe, family units persist until autumn (Dolgushin *et al.* 1970) and movements away from the natal area involve wandering juveniles (Labitte 1957). Few data are available on Crested Lark densities and distribution patterns outside the breeding season. Scattered observations mainly involve single individuals or small flocks (Abs 1963, Kozlova 1975, Viulleumier 1979). Temporal aggregations and short-distance movements are assumed to be related to bad weather (Porter *et al.* 1969), abundant food supply (Cramp 1988) and/or water supply (Rustamov 1958).

In this paper, we (i) introduce a new census technique, specially designed for standardized counts of ground-dwelling passerines in arid areas, and (ii) analyse non-breeding population densities and spatio-temporal distribution patterns of Crested Larks in relation to the characteristics of semi-desert habitat near Loiyengalani, Lake Turkana.

Study area and methods

Lake Turkana, 250 km long and reaching the Ethiopian border along its northern end, is the largest of the lakes in the Kenyan Rift Valley (Hughes & Hughes 1992). The region is characterized by extreme dryness (<200 mm annual rainfall, peak March–April) and is often subject to long periods of drought (Hopson 1982). Temperatures are high, with mean maxima over 32°C (Hopson 1982); during our study in February 1992, maximum daytime temperature ranged from 35 to 39°C. With these climatic features, the region can be considered a semi-desert (Pratt *et al.* 1966).

Our study area was in the southeastern part of the basin, close to the fishing village of Loiyengalani (2°46N, 36°43E). We censused Crested Larks along a stretch of shoreline some 3.2 km long, and inland to some 3 km from the lake. Most of this area consisted of large sand plains with sparse, scattered vegetation and variable amounts of pebble and rock. *Acacia tortilis* is the dominant tree, with Doum palm *Hyphaene compressa* and thickets of *Salvadora persica* growing around springs and along dry riverbeds. Meadow-like *Sporobolus spicatus* grass covers a belt some hundreds of metres inland from the lake, petering out as one moves further away from the shore.

Crested Lark populations were sampled between 14 January and 18 February 1992, using a specially-designed technique that we termed a circular-plot count (CPC). To perform a CPC, one observer stands stationary holding the end of a stretched string 56.4 m long (i.e., the radius of a 1-ha circle). The other walks around in a circle holding the opposite end. Birds are flushed or observed as the string passes over them, and all the birds seen inside the circle are recorded by the central observer. We carried out 78 CPCs in 50 different plots. For each CPC the following parameters were recorded: date, time of day, percentage of terrain covered by grass/pebbles, and distance from

human dwellings/lake (estimated to the nearest 10 per cent, with the aid of a map (HMSO, 1977) where appropriate).

Results

Table 1 shows the results of a Poisson regression model, selecting the best predictors of the number of birds observed in the different CPCs. The parameters of the model were estimated by maximum likelihood, which provides a convenient index of goodness-of-fit of a model including a particular set of parameters. Variables included in the model were date (10 different sampling days), period of day (morning: 07:00–11:00; mid-day: 11:00–15:00; evening: 15:00–19:00), percentage of terrain covered by grass, percentage of terrain covered by pebbles, distance from human dwellings and distance from the lake. We used a stepwise backward procedure in the statistical program GLIM (NAG 1986) to select a final model containing only significant parameters. In the final model, period of day and percentage of terrain covered by grass significantly affected the number of birds observed, with period being the strongest predictor.

Table 1. *Poisson regression model selecting parameters which best predict the number of birds per CPC. All parameters are tested with a stepwise backward procedure, calculating the change in* χ^2 *(approximately equivalent to scaled deviance) when a parameter is excluded from the model.* *, $P < 0.05$

Parameter	$\Delta\chi^2$	Δdf	P
Percentage pebbles	0.58	1	0.45
Distance from habitation	1.54	1	0.21
Distance from the lake	1.88	1	0.17
Date	15.35	9	0.08
Percentage grass cover	4.04	1	0.04*
Period of day	13.89	2	0.001*

Selected model: $G(x_i) = 0.35 (\pm 0.21) + 0.008 (\pm 0.003)$ grass cover - $0.44 (\pm 0.26)$ period of day.

The percentage of grass cover was positively, though weakly, related to number of birds per CPC ($n = 78$, $r = 0.215$, $P = 0.059$). To examine the effect of period of day on the number of birds per CPC in more detail, we selected 14 plots for which CPS were made in all three periods. The number of birds per CPC markedly decreased from morning to mid-day, and increased again from mid-day to evening, leaving no statistical difference between morning and evening (Repeated measures ANOVA: $F_{2,26} = 5.02$, $P = 0.014$; Fig. 1).

The presence of human dwellings did not tend to affect the distribution pattern of Crested Larks. However, our CPC technique could not be applied within villages. We often observed Crested Larks gathering around shops or houses were food was available, and densities could have been high.

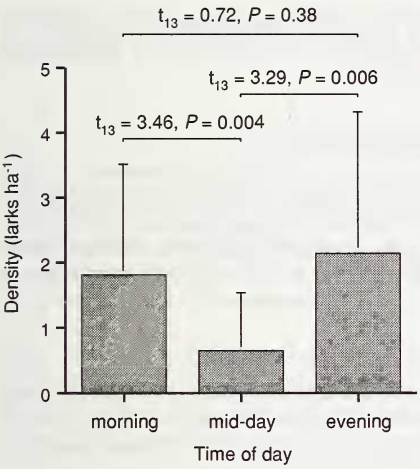

Figure 1. *Mean number of Crested Larks per plot, estimated with the circular plot count technique, in 14 plots counted in each period of the day. The* P*-values shown correspond to single paired t-tests*

The mean overall density of birds (individuals ha^{-1}) during the course of the day, estimated through CPCs, was 1.45. In the selected Poisson model, distance from the lake did not significantly affect the number of birds per CPC. However, higher densities were recorded in a belt of 100 m from the shore compared to further 'inland', although only during the morning period (Two-way ANOVA: factor Period, $F_{2,72}$ = 3.64, P = 0.031; factor Distance from Lake (<100 m versus >100 m), $F_{1,72}$ = 12.94, P = 0.001; two-factor interaction, $F_{2,72}$ = 2.68, P = 0.07).

Discussion

Crested Larks are the commonest passerines around Lake Turkana. If both the overall density observed in the course of our study (1.45 individuals ha^{-1}) and the habitat structure are similar to those found in other parts of the region, we can estimate that in an area of 2000 km^2 (i.e., a belt of about 4 km extended all around the shores of the lake), the population amounts to about 300 000 individuals. This very tentative estimate could be improved by carrying out additional counts in other areas. The CPC technique would be appropriate for this, and for censusing other ground-dwelling passerines in open habitats. It proved easy to perform, and appears to give consistent and accurate results.

CPCs carried out at different distances from the lake suggest a circadian pattern of movement between the lakeshore and the surrounding areas. Our results suggest that the birds were concentrated along the lakeshore during the early morning hours. Some of these birds apparently scatter inland during the day. During the hottest hours, when CPC numbers were at a minimum, the birds may concentrate around dwellings, in the shade of rocky cliffs, or at favoured drinking sites around springs or standpipes. We observed concentrations of birds at all these types of sites, but they are difficult to census with the CPC technique. One lark, captured and ringed at a drinking-site, was

later observed feeding 1 km away, so movements could be substantial. The afternoon appears to see the larks feeding in the open again as they begin a generalized movement back towards the lakeshore.

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